

WE CLAIM AS OUR INVENTION:

1. A feedback compensator for use in an acoustic amplification system to compensate feedback that acts on an input signal, upon amplification of said input signal, due to a feedback path from an amplified output signal, said feedback compensator comprising:

an adaptive feedback compensation filter that generates a compensation signal, from said amplified output signal, for compensating said feedback, said compensation signal being combined with said input signal; and

a frequency-limiting filter connected relative to said adaptive feedback compensation filter to limit a frequency range within which said adaptive feedback compensation filter compensates said feedback, said frequency-limiting filter having a filter function that is adaptable during compensation of said feedback by said adaptive feedback compensation filter.

2. A feedback compensator as claimed in claim 1 wherein said frequency-limiting filter is comprised of a plurality of individual filters, having respective filter functions that, in combination, form said filter function of said frequency-limiting filter.

3. A feedback compensator as claimed in claim 2 wherein said individual filters have respectively different filter functions, and wherein at least one of said individual filters is selectable to adapt said filter function of said frequency-limiting filter.

4. A feedback compensator as claimed in claim 2 wherein said feedback may occur within a frequency range, and wherein the respective filter functions of said individual filters, in combination, cover said frequency range.

5. A feedback compensator as claimed in claim 1 wherein said frequency-limiting filter has filter coefficients associated therewith, and wherein said filter function of said frequency-limiting filter is adapted by modification of said coefficients.

6. A feedback compensator as claimed in claim 1 wherein said amplified output signal is supplied to the adaptive feedback compensation filter through said frequency-limiting filter.

7. A feedback compensator as claimed in claim 1 further comprising a control unit connected to said frequency-limiting filter for adapting said filter function of said frequency-limiting filter.

8. A feedback compensator as claimed in claim 7 wherein said frequency-limiting filter is comprised of a plurality of individual filters having respectively different filter functions that in combination form said filter function of said frequency-limiting filter, and further comprising a changeover switch operated by said control unit to select at least one of said individual filters for adapting said filter function of said frequency-limiting filter.

9. A feedback compensator as claimed in claim 7 wherein said frequency-limiting filter has filter coefficients, and wherein said control unit adjusts at least one of said filter coefficients to adapt said filter function of said frequency-limiting filter.

10. A feedback compensator as claimed in claim 1 wherein said compensation signal is combined with said input signal to produce a feedback-compensated input signal, and wherein said feedback compensator further comprises an analysis unit connected to analyze said feedback-compensated input signal to determine an effectiveness of said feedback compensation.

11. A feedback compensator as claimed in claim 10 wherein said analysis unit determines said effectiveness of said feedback compensation by checking a parameter of said adaptive feedback compensation filter.

12. A feedback compensator as claimed in claim 10 wherein said analysis unit determines the effectiveness of said feedback compensation by comparing said feedback-compensated input signal to said output signal with regard to feedback content.

13. A feedback compensator as claimed in claim 10 wherein said analysis unit is an oscillation detector which measures said feedback in a frequency range.

14. A feedback compensator as claimed in claim 1 wherein said input signal is subject to feedback via an acoustic feedback path.

15. A feedback compensator as claimed in claim 1 wherein said input signal is subject to feedback via an electromagnetic feedback path.

16. A feedback compensator as claimed in claim 1 comprising an adaptation unit, connected to said adaptive feedback compensation filter, for modifying operation of said adaptive feedback compensation filter dependent on evaluation of a signal within said acoustic amplification system.

17. A feedback compensator as claimed in claim 16 wherein said adaptation unit is connected to receive said input signal for error signal evaluation thereof.

18. A feedback compensator as claimed in claim 17 wherein said input signal is supplied to said adaptation unit through a further frequency-limiting filter.

19. A feedback compensator as claimed in claim 18 wherein said further frequency-limiting filter has a filter function that is adaptable during compensation of said feedback by said adaptive feedback compensation filter.

20. A feedback compensator as claimed in claim 19 further comprising a control unit connected to said frequency-limiting filter and said further frequency-limiting filter to adapt the respective filter functions of said frequency-limiting filter and said further frequency-limiting filter.

21. A feedback compensator as claimed in claim 20 wherein said further frequency-limiting filter is comprised of a plurality of individual filters having respectively different filter functions that in combination form the filter function of said further frequency-limiting filter, and wherein said feedback compensator further comprises a changeover switch operated by said control unit to select at least one of said individual filters to adapt said filter function of said further frequency-limiting filter.

22. A feedback compensator as claimed in claim 20 wherein said further frequency-limiting filter has filter coefficients, and wherein said control unit adjusts at least one of said filter coefficients to adapt said filter function of said further frequency-limiting filter.

23. A feedback compensator as claimed in claim 16 wherein said adaptation unit is connected to receive an output of said frequency-limiting filter.

24. A feedback compensator as claimed in claim 23 further comprising a further feedback-limiting filter through which said output of said frequency-limiting filter is supplied to said adaptation unit.

25. A feedback compensator as claimed in claim 24 wherein said further frequency-limiting filter has a filter function that is adaptable during generation of said compensation of said feedback by said adaptive feedback compensation filter.

26. A feedback compensator as claimed in claim 25 further comprising a control unit connected to said frequency-limiting filter and said further frequency-limiting filter to adapt the respective filter functions of said frequency-limiting filter and said further frequency-limiting filter.

27. A feedback compensator as claimed in claim 26 wherein said further frequency-limiting filter is comprised of a plurality of individual filters having respectively different filter functions that in combination form the filter function of said further frequency-limiting filter, and wherein said feedback compensator further comprises a changeover switch operated by said control unit to select at least one of said individual filters to adapt said filter function of said further frequency-limiting filter.

28. A feedback compensator as claimed in claim 26 wherein said further frequency-limiting filter has filter coefficients, and wherein said control unit adjusts at least one of said filter coefficients to adapt said filter function of said further frequency-limiting filter.

29. A feedback compensator as claimed in claim 16 wherein said frequency-limiting filter is a first frequency-limiting filter, and wherein said adaptation unit is connected to receive said input signal and to receive an output from said first frequency-limiting filter, and wherein said feedback compensator further comprises a second frequency-limiting filter through which said input signal is supplied to said adaptation unit, and a third frequency-limiting filter through which said output from said first frequency-limiting filter is supplied to said adaptation unit.

30. A feedback compensator as claimed in claim 29 wherein said second frequency-limiting filter has a filter function that is substantially identical to a filter function of said third frequency-limiting filter.

31. A feedback compensator as claimed in claim 29 wherein each of said second and third frequency-limiting filters has a filter function that is adaptable during compensation signal of said feedback by said adaptive feedback compensation filter.

32. A feedback compensator as claimed in claim 31 further comprising a control unit connected to said first, second and third frequency-limiting filters for adapting the respective filter functions of said first, second and third frequency-limiting filters.

33. A feedback compensator as claimed in claim 32 wherein each of said second and third frequency-limiting filters is comprised of a plurality of individual filters having respectively different filter functions that in combination form the respective filter functions of said first, second and third frequency-limiting filters, and wherein said frequency compensator further comprises a first changeover switch operable by said control unit to select at least one of said individual filters of said second frequency-limiting filter to adapt the filter function of said second frequency-limiting filter, and a second changeover switch operable by said control unit to select at least one of the individual filters of said third frequency-limiting filter to adapt the filter function of the third frequency-limiting filter.

34. A feedback compensator as claimed in claim 32 wherein each of said second and third frequency-limiting filters has filter coefficients, and wherein said control unit adjusts at least one of the filter coefficients of said second frequency-limiting filter to adapt the filter function of the second frequency-limiting filter, and adjusts at least one of the filter coefficients of the third frequency-limiting filter to adapt the filter function of the third frequency-limiting filter.

35. A hearing aid comprising:

an input transducer that produces an input signal from an incoming acoustic signal;

a hearing aid signal processor supplied with said input signal that amplifies said input signal to produce an amplified output signal, said input signal being influenced by feedback, via a feedback path, upon amplification thereof;

an adaptive feedback compensation filter that generates a compensation signal, from said amplified output signal, for compensating said feedback, said compensation signal being combined with said input signal; and

a frequency-limiting filter connected relative to said adaptive feedback compensation filter that limits a frequency range within which said adaptive feedback compensation filter compensates said feedback, said frequency-limiting filter having a filter function that is adaptable during compensation of said feedback by said adaptive feedback compensation filter.

36. A method for compensating feedback in an acoustic amplification system, said feedback acting on an input signal, upon amplification of said input signal, due to a feedback path from an amplified output signal, said method comprising the steps of:

generating a compensation signal in an adaptive feedback compensation filter from said amplified output signal, for compensating said feedback, and combining said compensation signal with said input signal; and

limiting a frequency range within which said adaptive feedback compensation filter compensates said feedback with a frequency-limiting filter connected relative to said adaptive feedback compensation, and adapting a filter function of said frequency-limiting filter during compensation of said feedback by said adaptive feedback compensation filter.

37. A method as claimed in claim 36 comprising forming said frequency-limiting filter of a plurality of individual filters, having respective filter functions that, in combination, form said filter function of said frequency-limiting filter.

38. A method as claimed in claim 37 wherein said individual filters have respectively different filter functions, and selecting at least one of said individual filters to adapt said filter function of said frequency-limiting filter.

39. A method as claimed in claim 37 wherein said feedback may occur within a frequency range, and covering said frequency range with respective filter functions of said individual filters, in combination.

40. A method as claimed in claim 36 wherein said frequency-limiting filter has filter coefficients associated therewith, and comprising adapting said filter function of said frequency-limiting filter modification of said coefficients.

41. A method as claimed in claim 36 comprising supplying said amplified output signal to the adaptive feedback compensation filter through said frequency-limiting filter.

42. A method as claimed in claim 36 further comprising adapting said filter function of said frequency-limiting filter with a control unit connected to said frequency-limiting filter.

43. A method as claimed in claim 42 comprising forming said frequency-limiting filter of a plurality of individual filters having respectively different filter functions that in combination form said filter function of said frequency-limiting filter, and comprising operating a changeover switch operated with said control unit to select at least one of said individual filters for adapting said filter function of said frequency-limiting filter.

44. A method as claimed in claim 42 wherein said frequency-limiting filter has filter coefficients, and comprising adjusting at least one of said filter coefficients with said control unit to adapt said filter function of said frequency-limiting filter.

45. A method as claimed in claim 36 comprising combining said compensation signal with said input signal to produce a feedback-compensated input signal, and analyzing said feedback-compensated input signal to determine an effectiveness of said feedback compensation.

46. A method as claimed in claim 45 comprising determining said effectiveness of said feedback compensation by checking a parameter of said adaptive feedback compensation filter.

47. A method as claimed in claim 45 comprising determining the effectiveness of said feedback compensation by comparing said feedback-compensated input signal to said output signal with regard to feedback content.

48. A method as claimed in claim 42 comprising determining the effectiveness of said feedback compensation by measuring said feedback in a frequency range.

49. A method as claimed in claim 36 wherein said input signal is subject to feedback via an acoustic feedback path.

50. A method as claimed in claim 36 wherein said input signal is subject to feedback via an electromagnetic feedback path.

51. A method as claimed in claim 36 comprising connecting an adaptation unit to said adaptive feedback compensation filter, evaluating a signal within said acoustic amplification system in said adaptation unit, and modifying operation of said adaptive feedback compensation filter dependent on the evaluation.

52. A method as claimed in claim 51 comprising supplying said input signal to said adaptation unit for error signal evaluation thereof.

53. A method as claimed in claim 52 comprising supplying said input signal to said adaptation unit through a further frequency-limiting filter.

54. A method as claimed in claim 53 comprising adapting a filter function of said further frequency-limiting filter during said feedback compensation by said adaptive feedback compensation filter.

55. A method as claimed in claim 54 comprising adapting the respective filter functions of said frequency-limiting filter and said further frequency-limiting filter with a control unit connected to said frequency-limiting filter and said further frequency-limiting filter.

56. A method as claimed in claim 55 comprising forming wherein said further feedback-limiting filter of a plurality of individual filters having respectively different filter functions that in combination form the filter function of said further frequency-limiting filter, and operating a changeover switch with said control unit to select at least one of said individual filters to adapt said filter function of said further frequency-limiting filter.

57. A method as claimed in claim 55 wherein said further frequency-limiting filter has filter coefficients, and comprising adjusting at least one of said filter coefficients with said control unit to adapt said filter function of said further frequency-limiting filter.

58. A method as claimed in claim 51 comprising supplying an output of said frequency-limiting filter to said adaptation unit .

59. A method as claimed in claim 58 comprising supplying said output of said frequency-limiting filter to said adaptation unit through a further frequency-limiting filter.

60. A method as claimed in claim 59 comprising adapting a filter function of wherein said further frequency-limiting filter during said feedback compensation by said adaptive feedback compensation filter.

61. A method as claimed in claim 60 comprising connecting a control unit to said frequency-limiting filter and said further frequency-limiting filter and adapting the respective filter functions of said frequency-limiting filter and said further frequency-limiting filter with said control unit.

62. A method as claimed in claim 61 comprising forming said further feedback-limiting filter of a plurality of individual filters having respectively different filter functions that in combination form the filter function of said further frequency-limiting filter, and operating a changeover switch with said control unit to select at least one of said individual filters to adapt said filter function of said further frequency-limiting filter.

63. A method as claimed in claim 61 wherein said further frequency-limiting filter has filter coefficients, and comprising adjusting at least one of said filter coefficients with said control unit to adapt said filter function of said further frequency-limiting filter.

64. A method as claimed in claim 51 wherein said frequency-limiting filter is a first frequency-limiting filter, and connecting said adaptation unit to receive said input signal and to receive an output from said first frequency-limiting filter, and supplying said input signal to said adaptation unit through a second frequency-limiting filter, and supplying said output from said first frequency-limiting filter to said adaptation unit through a third frequency-limiting filter.

65. A method as claimed in claim 64 comprising providing said second frequency-limiting filter with a filter function that is substantially identical to a filter function of said third frequency-limiting filter.

66. A method as claimed in claim 64 comprising adapting respective filter functions of said second and third frequency-limiting filters during said feedback compensation by said adaptive feedback compensation filter.

67. A method as claimed in claim 61 comprising connecting a control unit to said first, second and third frequency-limiting filters and adapting the respective filter functions of said first, second and third frequency-limiting filters with said control unit.

68. A method as claimed in claim 67 comprising forming each of said second and third frequency-limiting filters of a plurality of individual filters having respectively different filter functions that in combination form the respective filter functions of said first, second and third frequency-limiting filters, and operating a first changeover switch with said control unit to select at least one of said individual filters

of said second frequency-limiting filter to adapt the filter function of said second frequency-limiting filter, and operating a second changeover switch with said control unit to select at least one of the individual filters of said third frequency-limiting filter to adapt the filter function of the third frequency-limiting filter.

69. A method as claimed in claim 67 wherein each of said second and third frequency-limiting filters has filter coefficients, and comprising adjusting at least one of the filter coefficients of said second frequency-limiting filter with said control unit to adapt the filter function of the second frequency-limiting filter, and adjusting at least one of the filter coefficients of the third frequency-limiting filter with said control unit to adapt the filter function of the third frequency-limiting filter.